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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/819,552	03/28/2001	Calvin T. Gabriel	39153/310 (F0797)	3369

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EXAMINER

TRAN, BINH X

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 11/06/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/819,552	GABRIEL ET AL.	
	Examiner	Art Unit	
	Binh X Tran	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 October 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-15 and 24-31 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-15 and 24-31 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
 If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☐ All b) ☐ Some * c) ☐ None of:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
 * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
 a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

07/30/01
11/19/02
12/02/02
09/26/03

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of Group I in Paper filed on 10-23-2003 is acknowledged.

The applicants' cancellation of the Group II (claims 16-23) drawn to non-elected invention in Paper filed on 10-23-2003 is also acknowledged.

Specification

2. The disclosure is objected to because of the following informalities: In page 1 under the "Cross reference to related applications", the examiner suggests the applicants to update this section. The updated information must include the US Application No., filing date and the current status of each application.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 4, 31 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 4, "the etch stability is increased by 20-50%" is vague and indefinite. It is unclear from the claim whether the "unit" of the etch stability need to be defined. There is a percentage, but the units of the percentage were not defined.

In claim 31, "selected from a group including" is indefinite for improper use of Markush language. The examiner suggests replacing "selected from a group including" to --selected from the group consisting of--.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

7. Claims 1-11, 13-15, 24-29, 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dunne et al. (US 6,207,583) in view of Sato et al. (US 6,054,254).

Dunne discloses a method comprising:

providing a photoresist layer, for use in vacuum ultraviolet lithography (col. 6 lines 1-5, Fig 1c, Fig 5a);

exposing the photoresist layer to a plasma, the photoresist layer including exposed surfaces (col. 8);
transforming the exposed surface to form a shell (22 or 43), wherein the shell increase the etch stability of the photoresist layer (col. 8, Fig 1d, Fig 5b).

Dunne fails to disclose the specific thickness of the photoresist layer. In a semiconductor process, Sato discloses a photoresist layer (8) having a thickness of 200 nm is sufficient to act as a mask (col. 74 lines 17-21; Note: 200 nm = 0.2 μ m; read on "thickness less than 0.25 μ m"). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Dunne in view of Sato by having the thickness less than 0.25 μ m because it would be sufficient to act as a mask.

Respect to claim 2, Dunne discloses the plasma process is a fluorine-based plasma (i.e., CF₄ plasma, See col. 9). Respect to claims 3-5, the cited prior arts differ from the invention by the specific value of flow rate, pressure, RF power, temperature, etch stability. However, Dunne clearly discloses that flow rate, pressure, RF power, temperature, etch stability is a result effective variable. Sato discloses the thickness or depth of the transforming photoresist layer is a also result effective variable. The result effective variables are commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the time of invention, to perform routine experiments to obtain optimal values as an expected result.

Respect to claim 6, Dunne teaches the transforming step includes densification of the exposed surface to form harden shell (22 or 43). Sato also teaches to cross-linking the photoresist layer to form harden sell (12) (See col. 74 lines 45-55).

Respect to claim 7, Dunne discloses the process comprising:

- patterning a feature on a photoresist layer disposed over a substrate, the feature patterned in according with a patterned mask with UV radiation;

- developing the photoresist layer, the patterned photoresist layer including at least one feature having a top surface and side surface (Fig 1c, Fig 5a);

- exposing the photoresist layer to a densifier (i.e. plasma);

- transforming the top surface and side surface with the densifier to form a harden surface to produce etch stability (Fig 1d, Fig 5b);

- etching the substrate in according the transform feature, wherein the exposing step occurs after the developing step.

Dunne does not explicitly disclose the exposing step occurs before the etching step. Sato discloses the exposing the photoresist layer to a densifier before the etching step (Fig 4E-Fig 4F). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Dunne in view of Sato by performing the exposing step before the etching step because it would enhance the photoresist mask.

Dunne also does not explicitly disclose the radiation is at deep UV. However, Dunne clearly discloses the radiation is at UV wavelength. Sato discloses the radiation is at 248 nm or 222 nm (read on "deep ultraviolet"; col. 49 lines 5-15). It would have

been obvious to one having ordinary skill in the art, at the time of invention, to perform at deep UV radiation because this would create a fine pattern dimension.

The limitation of claims 8-10, 13-15 has been discussed above. Respect to claim 11, Sato discloses the densifier is performed using ArF excimer laser (col. 77 lines 23-30). However, Sato also teaches that electron beam can be used to substitute for ArF laser (col. 49 lines 10-16). It would have been obvious to one having ordinary skill in the art, at the time of invention, to use electron beam because equivalent and substitution of one for the other would produce an expected result.

The limitation of claims 24-28 has been discussed. Respect to claim 29, Sato discloses the photoresist layer contains phenolic resin (col. 82 lines 45-47). Respect to claim 31, Dunne discloses the feature is via structure (20).

8. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dunne and Sato as applied to claim 7 above, and further in view of Mullee et al. (US 6,500,605).

Both Dunne and Sato disclose the step of densifier the photoresist layer. However, Dunne and Sato fail to explicitly disclose that the densifier is an ion implantation. Mullee discloses the step of ion implantation to create a hard crust on the photoresist layer as doping the source and drain regions. It would have been obvious to one having ordinary skill in the art, at the time of invention, to use ion implantation because this would reduce the processing time by harden the photoresist layer and doping the source/drain regions at the same time.

9. Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dunne and Sato as applied to claim 24 above, and further in view of Wong et al. (US 6,319,655).

Sato teaches the polymer photoresist is lithographically patterned using 193 nm wavelength (col. 49 lines 10-15). However, Dunne and Sato fail to disclose that the photoresist comprises an acrylate or alicyclic polymer. Wong teaches the photoresist layer comprises acrylate or alicyclic polymer and it is patterned using light at having a wavelength at 193 nm. It would have been obvious to one having ordinary skill in the art, at the time of invention, to use acrylate or alicyclic polymer because this would increase etch resistance of the photoresist layer.

Conclusion

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. "Deep-UV Lithography", <http://courses.nus.edu.sg/course/phyweets/Projects98/OPTICAL/deep.html> defines that deep-UV region generally accepted to be in the regions between 200-300 nm.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Binh X Tran whose telephone number is (703) 308-1867. The examiner can normally be reached on Monday-Thursday and every other Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G Norton can be reached on (703) 305-2667. The fax phone

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number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Binh X. Tran

SUPERVISOR NADINE G. NORTON
PRIMARY EXAMINER
Nadine Norton